Space Weather Technical Forecast

Issued on Thursday, 20 June 2024 at 01:09 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: M-class flares likely (R1-R2 radio blackouts), slight chance of X-flares (R3 blackouts). Slight chance of S1/Minor radiation storm.

Analysis of Space Weather Activity over past 24 hours
Solar Activity: Solar activity has been Moderate with an M1.1 flare at 19/0638 UTC from AR3711. There are now six sunspot regions on the disc. The largest region remains AR3712 in the southwest, however it has started to pull apart in recent hours, with the delta region no longer obvious in imagery. AR3713 also in the southwest has continued to increase in size and complexity, having developed a large delta region in one of its leading spots. AR3716 in the northwest has also seen growth in its trailing spots, with a small delta region appearing. AR3719 and AR3720 are both still very close to the southeast limb, meaning they are currently difficult to analyse due to foreshortening effects.
No obviously Earth directed CMEs have been seen in the last 24 hours.

Solar Wind / Geomagnetic Activity: Solar winds, as observed by ACE at L1, showed declining fast wind influence from CH45/+. Wind speeds were elevated between 510-570 km/s, gradually declining after 19/1800 UTC to around 480 km/s. Density was below average throughout. Interplanetary Magnetic Field, Bt, was weak, below 6nT. The north-south component, Bz, varied weakly between +/-5nT. Phi angle was predominantly positive (away from the Sun). Geomagnetic activity has been Quiet to Unsettled (Kp 1-3).

Energetic Particles / Solar Radiation: The high energy (greater than 10 MeV) proton flux observed by GOES18 remained at background levels. High energy electron flux (greater than 2MeV) observed by GOES16 reached moderate levels, peaking at 410 pfu at 19/1530. The 24-hour fluence was below Active on a rising trend, reaching 9.7e6 integrated pfu at 20/0000 UTC.

Four-Day Space Weather Forecast Summary
Solar Activity: M-flares are likely, with a slight chance of isolated X-class flares, most likely from AR3712 or AR3713, but potentially also AR3716.

Solar Wind / Geomagnetic Activity: No obviously Earth directed CMEs have been seen in coronagraph imagery, although given the number of recent CMEs there is some uncertainty. Wind speeds have been elevated due to CH45/+, and are expected to continue to slowly decline over the next couple of days. A further enhancement from the large coronal hole CH46/- in the northern disc is possible, although confidence is currently low in the timing and strength of this feature. Wind speeds potentially returning to slightly elevated, perhaps elevated, by the end of Day 2 or into Day 3 (21-22 Jun). Any geomagnetic response is expected to be limited at this time of year.
Mainly Quiet to Unsettled geomagnetic activity is expected. There is a chance of isolated Active intervals Day 2 into Day 3, should we see any HSS enhancement from CH46.

Energetic Particles / Solar Radiation: High energy proton flux is expected to remain at background levels, but with the potential to rise, should any notable flares occur. This gives a slight chance of reaching the S1/Minor solar radiation storm level. High energy electron flux is

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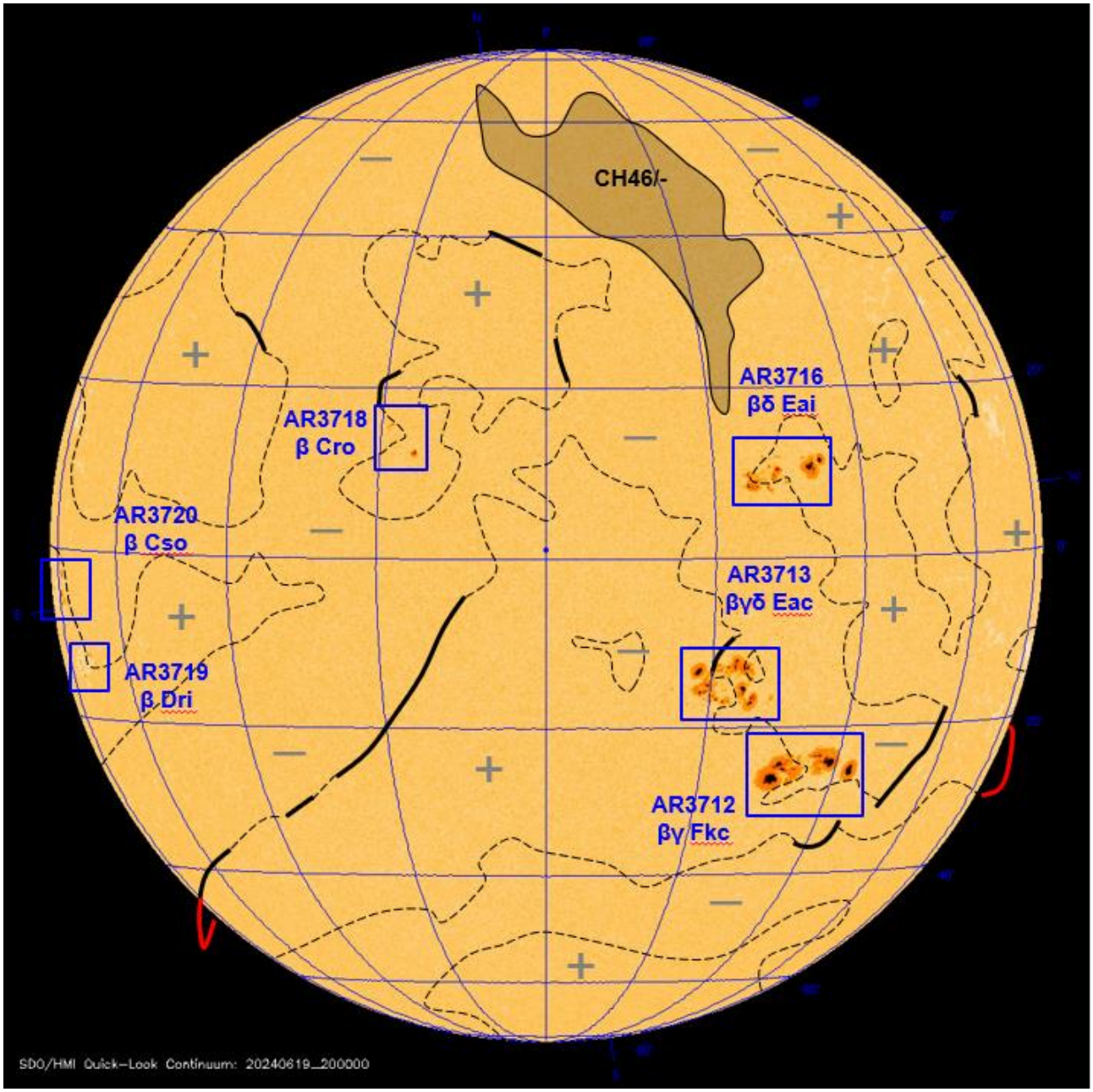
forecast to be at background to moderate levels. The associated 24-hour fluence is expected to remain below the Active threshold, but with a slight rising trend.

Figure 1. Solar Analysis Valid 19/2000 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

A filament eruption occurred in the northeast of the disc at 19/0918UTC and looked like it could give a CME heading towards Earth. However, there is no sign of this CME in coronagraph imagery so it seems likely that the majority of it has been re-absorbed. Otherwise, no obviously Earth directed CMEs have been seen in imagery, although given the number of recent CMEs there is some uncertainty.

Wind speeds are currently elevated due to CH45/+, and are expected to continue to slowly decline over the next couple of days as this coronal hole rotates away. MOSWOC Enlil is currently suggesting a further enhancement from the large coronal hole CH46/- in the northern disc, although it is suggesting that Earth should already be entering this High Speed Stream (HSS). This is currently thought to be over-estimated in both strength and southern extent in Enlil, as well as too early in the timing, with 27-day persistence supporting this. No significant enhancement was observed on the previous rotation, however given the slightly more northward location of Earth, a slight increase is considered possible on this rotation but with low confidence. Wind speeds potentially returning to slightly elevated, perhaps elevated, by the end of Day 2 or into Day 3 (21-22 Jun). Any geomagnetic response is expected to be limited at this time of year.

Mainly Quiet to Unsettled geomagnetic activity is expected. There is a chance of isolated Active intervals Day 2 into Day 3, should we see any HSS enhancement from CH46.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	5	5	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

No Earth directed CMEs are currently expected.

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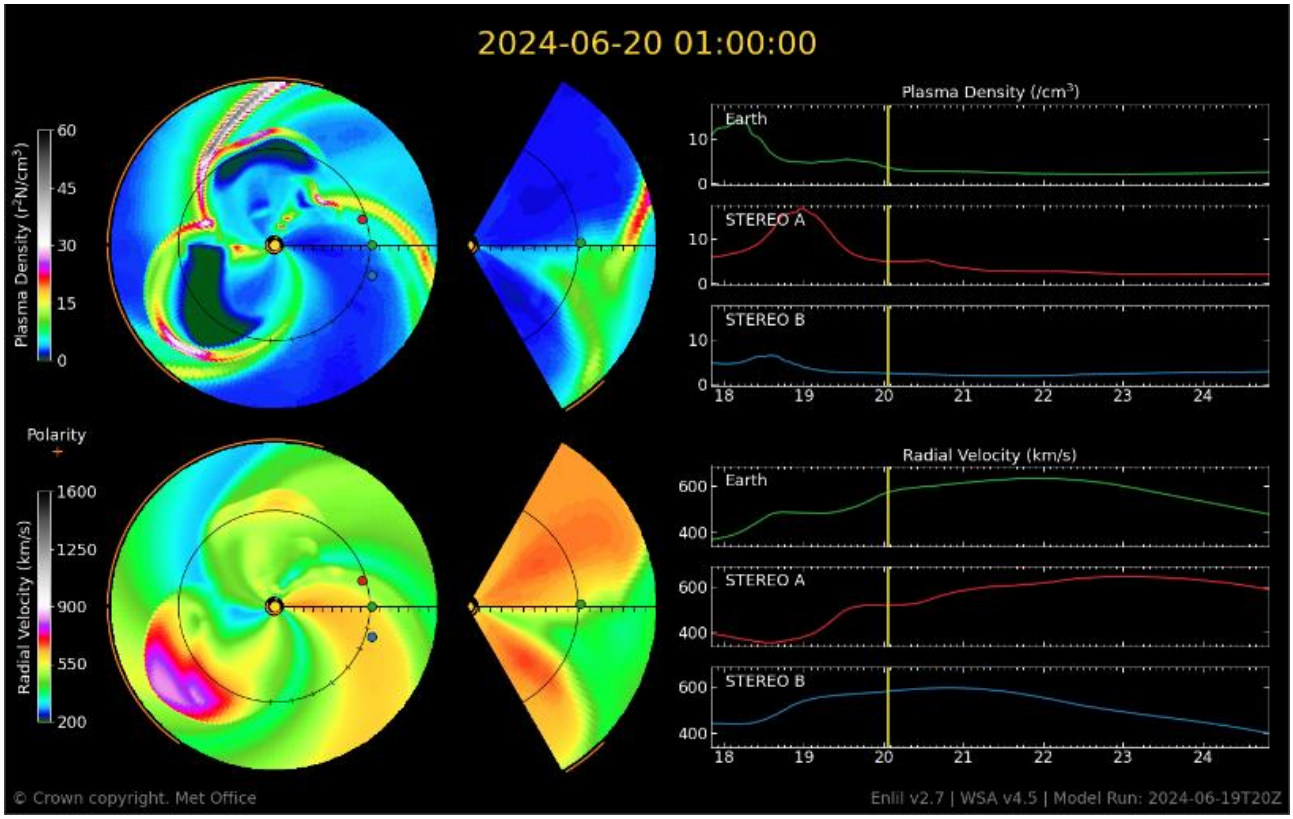
Figure 2: MOSWOC Enlil, which is currently thought to be early with the onset of the next HSS from CH46, and overestimating the strength.



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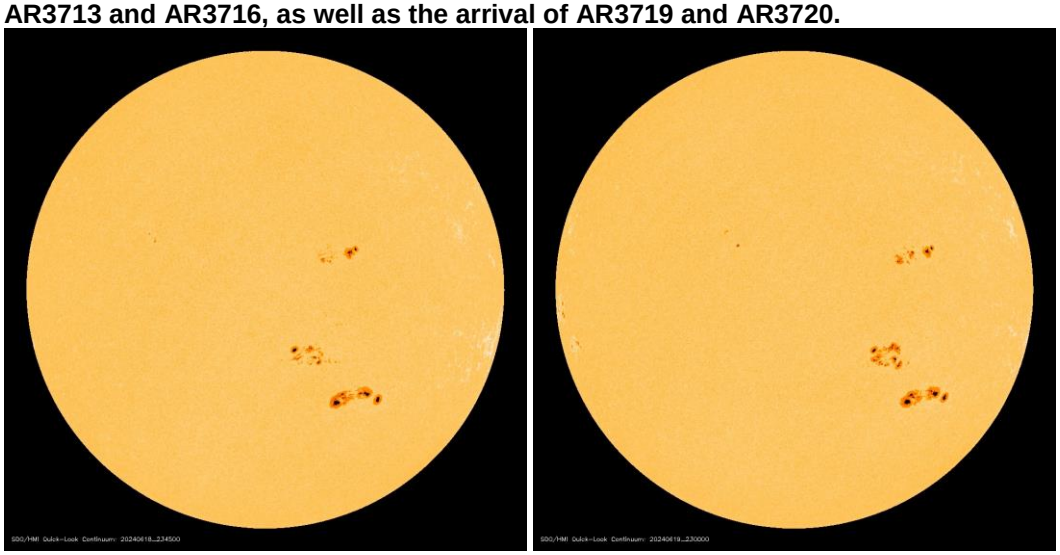
Radio Blackouts - X-Ray Flares:
There are now six sunspot regions on the disc, with AR3711 having rotated off and the two new regions on the southeast limb having been numbered. The largest region remains AR3712 (Fkc/Beta-Gamma), however it has started to pull apart in recent hours, with the delta region no longer obvious in imagery, although it does retain some magnetic complexity within its intermediate portion. AR3713 (Eac/Beta-Gamma-Delta) has continued to increase in size and complexity, having developed a large delta region in one of its leading spots. AR3716 (Eai/Beta-Delta) has also seen growth in its trailing spots, with a small delta region appearing. AR3719 and AR3720 are both still very close to the east limb, meaning they are difficult to analyse due to foreshortening effects. Their classification is likely to change as they rotate further onto the disc and become more clearly visible.

There are a number of potential returning regions in the period, however seismic data and current imagery at the east limb do not appear to show any particularly significant regions are imminent.

Solar activity has been Moderate with an M1.1 flare at 19/0638 UTC from AR3711. Further M-flares are likely, with a slight chance of isolated X-class flares, most likely from AR3712 or AR3713, but potentially also AR3716.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	Yes	70	70	70	70
Very Active	R3 to R5 X Class	No	20	20	20	20

Figure 3: SDO intensitygram at 18/2345 UTC (left) and 19/2300 UTC (right), showing the growth of AR3713 and AR3716, as well as the arrival of AR3719 and AR3720.



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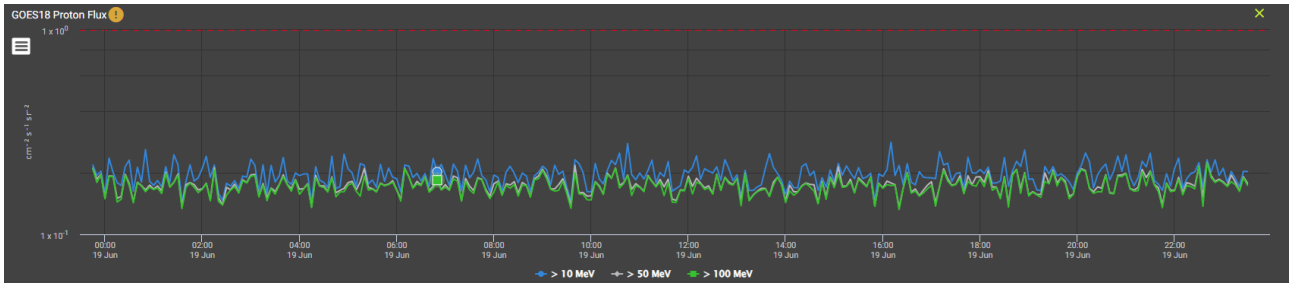
Solar Radiation Storms - (High Energy Protons):
GOES-18 proton flux remains at background levels, with no solar radiation storms occurring. However any significant flares, from any of the three larger regions in the western disc, have the potential to increase the observed flux at GOES. This brings a slight chance of reaching the S1 Minor Storm threshold, with this risk increasing slightly as these regions move further across the western part of the solar disc.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	15	20	20	20
Very Active	**≥ S3 ***	No	1	1	1	1

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)

Figure 4: Proton flux at GOES18, which is at background levels.



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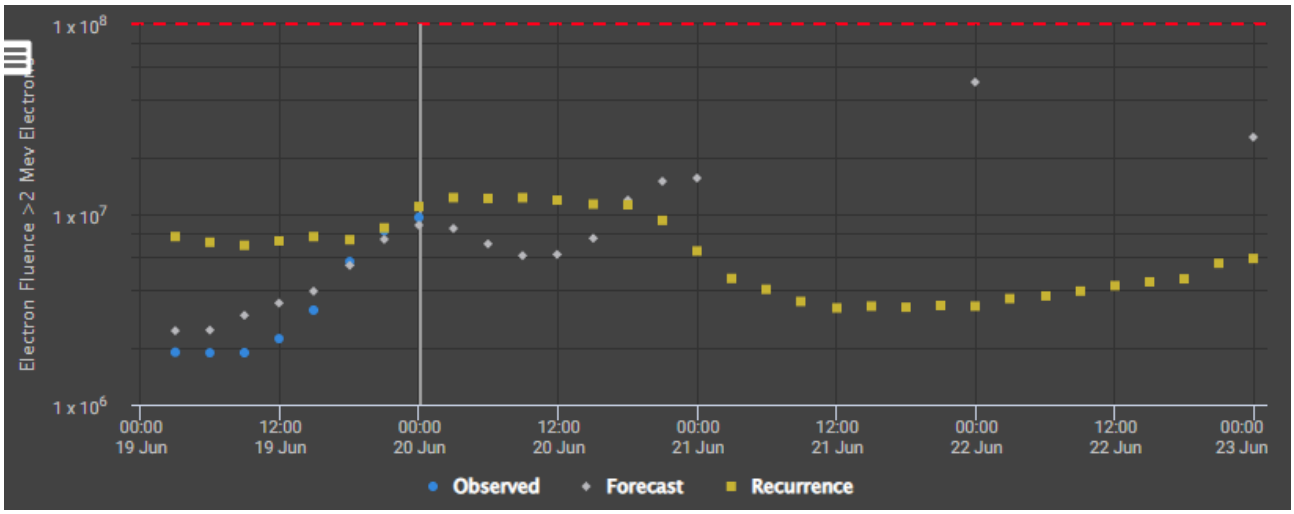
High Energy Electrons Event (≥ 2MeV):
High energy electron flux, as observed by GOES-16, reached moderate levels at the diurnal maximum on 19 June as a consequence of the current fast wind enhancement from CH45/+. Electron flux is likely to continue peaking at moderate levels over the next couple of days, before the potential onset of the HSS from CH46/-, which could suppress electron flux once again. The British Antarctic Survey radiation belt model suggests that any flux increase due to CH45 has been minor, which seems reasonable given the lack of geomagnetic response to CH45, with flux levels likely to remain at background to moderate levels.

The associated electron fluence is expected to persist below the Active threshold (1e8 integrated pfu), perhaps rising a little in response to the recent enhancement. MOSWOC REFM is suggesting a rise below the Active level, which is currently considered to be good guidance.

GEO Electron Environment	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ $1x10^8$	No	5	5	5	1
Very Active	≥ 2 MeV ≥ $1x10^9$	No	1	1	1	1

Figure 5: MOSWOC REFM, forecasting a rise in fluence but below the Active threshold.



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